

AMENDMENTS TO THE SPECIFICATION

The following is a marked-up version of the specification with the language that is underlined (“ ”) being added and the language that contains strikethrough (“”) being deleted:

In the CROSS-REFERENCE TO RELATED APPLICATION section:

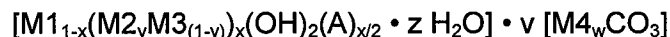
(starting at page 1, paragraph 1):

This application claims priority to copending U.S. Provisional Application entitled, “Improved High Temperature CO₂ Absorbent”, filed with the United States Patent and Trademark Office on June 19th 2002, and assigned Serial No. 60/390,050, and, U.S. Provisional Application entitled, “Temperature Swing Process for Selectively Removing Carbon Dioxide from a ~~process stream~~ Process Stream”, filed with the United States Patent and Trademark Office on February 24th 2003, and assigned Serial No. 60/449,689, both of which are entirely incorporated herein by reference.

In the DETAILED DESCRIPTION section:

(starting at page 6, paragraph 1):

Embodiments of the LDH compositions include alkali metal promoted, mixed trivalent metal LDH compositions. In particular, the alkali metal promoted, mixed trivalent metal LDH compositions include compositions having the following general formula:



wherein the subscript “x” is a number between 0 and 1; the subscript “y” is a number ranging from greater than 0 to about 0.05, preferably from greater than 0 to about 0.0375; “z” is a number ranging from 0 to about 8, preferably from 0 to about 4; the subscript “w” is the integer 1 or 2, wherein when “w” is the integer 1 the CO₃ becomes HCO₃; “v” is a number ranging from 0 to about 0.01, preferably from 0 to 0.0025; “M1” is a divalent metal such as, but not limited to, magnesium (Mg), calcium (Ca), strontium (Sr), manganese (Mn), iron (Fe), cobalt (Co), nickel (Ni), copper (Cu), and zinc (Zn); “M2” and “M3” are each a trivalent metal such as, but not limited to, aluminum (Al), chromium (Cr), Manganese (Mn), Iron (Fe), Cobalt (Co), lanthanum (La), cerium (Ce), gallium (Ga), indium (In), the lanthanide series of metals, and mixtures thereof; “A” is an anion such as, but not limited to, CO₃, SO₄, and HPO₄; and “M4” is an alkali metal such as, but not limited to, sodium (Na), potassium (K), rubidium (Rb), cesium (Cs), and lithium (Li). In an exemplary embodiment, “M1” is Mg; “M2” is Al, Ga, or La; “M3” is a trivalent metal such as Ga, La, In, or the lanthanide series of metals; at least one of “M2” and “M3” is Al; “M4” is K.

(starting at page 8, paragraph 3):

Another embodiment of the alkali metal promoted mixed trivalent metal LDH compositions includes, but is not limited to, lanthanum-containing mixed trivalent compositions having the formula $[\text{Mg}_6\text{Al}_{2(1-q)}\text{La}_{2q}(\text{OH})_{16}\text{CO}_3 \cdot 4\text{H}_2\text{O}] \cdot r(\text{K}_2\text{CO}_3)$ wherein the subscript "r" can range from greater than 0 to about 0.02 or preferably from greater than 0 to about 0.01 and the subscript "q" can range from greater than 0 to about 0.1 or preferably from about 0.001 to 0.05. The lanthanum-containing mixed trivalent composition forms a lanthanum-containing mixed trivalent metal adsorbent when heated to at least one temperature ranging from about 300°C to less than 450°C at a pressure of one atmosphere.

(starting at page 9, paragraph 1):

The exemplary alkali metal promoted, mixed trivalent metal LDH compositions discussed above can be synthesized by mixing divalent and trivalent metal-containing chloride, carbonate, or nitrate compounds with a trivalent-containing chloride, carbonate, or nitrate ~~compound~~ compounds in a solution of aqueous alkali metal carbonate such as, but not limited to, sodium carbonate. The solution is mixed and maintained at a pH of about 10 by adding a base such as, but not limited to, sodium hydroxide to the mixture. If the starting compounds are chlorides, the resulting precipitate, (the mixed, trivalent metal LDH composition) is rinsed of chloride ions using distilled and/or decarbonated water under appropriate conditions. The mixed trivalent metal LDH composition is then dried, crushed, and stored under appropriate conditions. The mixed trivalent metal LDH composition can be a LDH chloride compound, a LDH carbonate compound, or a LDH nitrate compound. In an exemplary embodiment, the mixed trivalent metal LDH composition is a LDH carbonate compound.

(starting at page 9, paragraph 3):

The concentrations and quantities of the materials used in the synthesis of the alkali metal promoted, mixed trivalent metal LDH composition depend in part upon the alkali metal promoted, mixed trivalent metal LDH composition formed, as defined above. In general, the stoichiometric ratio of the metal chlorides, carbonates, or nitrates used in the synthesis of the alkali metal promoted, mixed trivalent metal LDH composition, was held at $\text{M}^{2+}:\text{M}^{3+}$ of 3:1. For example, when referring to the instance of 10% substitution of Ga for Al, the ratio of Mg:Al:Ga of the synthesis materials is 3:0.9:0.1. However, one skilled in the art would be able to determine the concentrations and quantities of the materials, and the stoichiometric ratios needed to ~~synthesizesynthesis~~ the alkali metal promoted, mixed trivalent metal LDH composition described above.

(starting at page 10, paragraph 1):

Embodiments of the present invention also include methods of separating one or more gases from a gas mixture using a cyclic adsorption process. In general, the cyclic adsorption process can be carried out in one of the following cyclic adsorption process configurations: a pressure swing adsorption apparatus, a temperature swing adsorption apparatus, or a pressure swing/temperature swing adsorption apparatus, all of which are known in the art. In general, each type of cyclic adsorption apparatus includes an adsorption zone and a desorption zone, although in some instances both zones are in

the same physical area and the conditions within the physical area are altered, as is discussed in more detail below.

(starting at page 11, paragraph 2):

An embodiment of a representative temperature swing method includes passing the gas mixture stream through at least one adsorption zone of the cyclic adsorption process that contains the LDH composition. Prior to being exposed to the gas mixture, the LDH composition is calcined at a temperature of about 350°C to 450°C in an inert gas. The gas mixture can include a plurality of gases such as, but not limited to, CO₂, water vapor, hydrocarbons, carbon monoxide, hydrogen (H₂), nitrogen (N₂), and oxygen (O₂). The hydrocarbons can include mixtures of light hydrocarbons such as, but are not limited to, naphtha, methane, ethane, and ethene, or combinations thereof.

(starting at page 13, paragraph 2):

The temperature of the adsorption zone for cyclic adsorption processes depends upon a number of factors, such as, but not limited to, the particular hydrocarbons present in the gas mixture being separated, the particular adsorbent being used, and the pressure at which the adsorption step is carried out. The upper and lower temperatures at which the adsorption zone is maintained is, in part, determined by both economics and the chemical reactivity of the components in the gas mixture. In particular, the temperature at which the adsorption zone is maintained should be below the temperature at which the gas mixture components undergo chemical reaction (e.g., hydrocarbons undergoing oligomerization and polymerization). In general, the temperature in the adsorption zone is in the range of about 0°C to 250°C, preferably in the range of about 100°C to 200°C, and most preferably in the range of about 100°C to 160°C, when CO₂ is being separated from hydrocarbons such as, but not limited to, alkanes, alkenes, or mixtures of these. However, one skilled in the art would be able to adjust the temperature, as well as other parameters in the cyclic adsorption process, to ensure efficient and effective adsorption of CO₂.

(starting at page 18, paragraph 2):

Four exemplary adsorbents were prepared (in a manner consistent with those ~~method~~methods described herein) and examined: LDH compositions having Mg/Al in a 3/1 ratio, (1) promoted with K₂CO₃ and (2) unpromoted; LDH compositions having Mg/Al/Ga in a 3/0.9/0.1 ratio, (3) promoted with K₂CO₃ and (2) unpromoted; and LDH compositions having Mg/Al/Ga in a 3/0.9/0.1 ratio, (3) promoted and (4) unpromoted. These samples (0.2 g each) were placed in a fixed bed adsorber operated at a total pressure of 30 psia that was installed in a controlled furnace.

(starting at page 18, paragraph 3):

Inert gas (He, 30 STP cm³/minute) was passed over this solid and thence to a CO₂ analyzer to analyze for the CO₂ concentration in the effluent gas. Data of CO₂ concentrations, as a function of time, were recorded by a PC stored for further processing. The temperature of the adsorbent bed was heated from 100 to 450°C at a linear rate of

2°C/minute, and then the temperature was held constant for 30 minutes so that the LDH is to be fully converted to the calcined solid.